

--13. A signal transmission apparatus comprising:

a receiver operable to receive an input signal containing a first data stream of n values and a second data stream, where n is an integer;

a modulator operable to modulate a carrier wave with the received input signal so as to produce a modulated signal having symbols each representing a corresponding one of m signal points in a signal space, where m is an integer, said modulator including

a divider operable to divide the m signal points into n signal point groups,

an assignor operable to assign n values of the first data stream to the n signal point groups, respectively, and to assign data of the second data stream to the signal points of each of the n signal point groups, and

a shifter operable to shift the signal points of the received signal to other positions in the signal space such that a distance between any closest two signal points of any adjacent two signal point groups becomes $2\delta * S$ and the signal points in each of the signal point groups are allocated in the signal space at equal intervals, and such that the m signal points are distinguishable from one another in the signal space by a first set of thresholds, which divide the signal space into m regions, and the n signal point groups are distinguishable from one another in the signal space by a second set of thresholds, which divide the signal space more coarsely than the first set of thresholds into n regions, where 2δ is a distance between the closest two signal points of the adjacent two signal point groups when the m signal points are allocated in the signal space at equal intervals, and S is a shift coefficient which is more than one;

a transmitter operable to transmit the modulated signal and to transmit information necessary for determining the first and second sets of thresholds.

14. A signal transmission apparatus according to claim 13, wherein each of the first and second data streams carries information constituting a television image.

15. A signal receiving apparatus comprising:

a receiver operable to receive a signal having symbols each representing a corresponding one of m signal points in a signal space, where m is an integer, wherein the m signal points are divided into n signal point groups each containing m/n signal points, and the signal points are shifted to other positions in the signal space so that a distance between any closest two signal points of any adjacent two signal point groups is $2\delta * S$ and the signal points in each of the signal point groups are allocated in the signal space at equal intervals and the m/n signal points in each of the n signal point groups are distinguishable from one another in the signal space by a first set of thresholds and the n signal point groups are distinguishable from one another in the signal space by a second set of thresholds, where 2δ is a distance between the closest two signal points of the adjacent two signal point groups when the m signal points are allocated in the signal space at equal intervals, and S is a shift coefficient which is more than one, and wherein the signal contains a first data stream, which is assigned to the n signal point groups, a second data stream, which is assigned to the m/n signal points of each of the n signal point groups, and information necessary for determining the first and second sets of thresholds;

a demodulator operable to extract the information necessary for determining the first and second sets of thresholds from the received signal, set at least one of the first and second thresholds based on the information necessary for determining the first and second sets of thresholds, distinguish the n signal point groups from one another by the second set of thresholds and demodulate values of the distinguished n signal point groups to obtain reconstructed data of the first data stream, and to distinguish the m/n signal points in each of the n signal point groups by the first set of thresholds and demodulate values of the distinguished m/n signal points in each of the n signal point groups to obtain reconstructed data of the second data stream; and

an output circuit operable to combine the reconstructed data of the first and second data streams from said demodulator to obtain reconstructed data from the received signal.

16. A signal transmission apparatus according to claim 15, wherein each of the first and second data streams carries information constituting a television image.

17. A signal transmission system comprising:

a first receiver operable to receive an input signal containing a first data stream of n values and a second data stream, where n is an integer;

a modulator operable to modulate a carrier wave with the received input signal so as to produce a modulated signal having symbols each representing a corresponding one of m signal points in a signal space, where m is an integer, said modulator including

a divider operable to divide the m signal points into n signal point groups,

an assignor operable to assign n values of the first data stream to the n signal point groups, respectively, and to assign data of the second data stream to the signal points of each of the n signal point groups, and

a shifter operable to shift the signal points of the received signal to other positions in the signal space such that a distance between any closest two signal points of any adjacent two signal point groups becomes $2\delta * S$ and the signal points in each of the signal point groups are allocated in the signal space at equal intervals, and such that the m signal points are distinguishable from one another in the signal space by a first set of thresholds, which divide the signal space into m regions, and the n signal point groups are distinguishable from one another in the signal space by a second set of thresholds, which divide the signal space more coarsely than the first set of thresholds into n regions, where 2δ is a distance between the closest two signal points of the adjacent two signal point groups when the m signal points are allocated in the signal space at equal intervals, and S is a shift coefficient which is more than one;

a transmitter operable to transmit the modulated signal and to transmit information necessary for determining the first and second sets of thresholds;

a second receiver operable to receive the modulated signal;

a demodulator operable to extract the information necessary for determining the first and second sets of thresholds from the received signal, set at least one of the first and second thresholds based on the information necessary for determining the first and second sets of thresholds, distinguish the n signal point groups from one another by the second set of thresholds and demodulate values of

the distinguished n signal point groups to obtain reconstructed data of the first data stream, and to distinguish the m signal points in each of the n signal point groups by the first set of thresholds and demodulate values of the distinguished m signal points in each of the n signal point groups to obtain reconstructed data of the second data stream; and

an output circuit operable to combine the reconstructed data of the first and second data streams from said demodulator to obtain reconstructed data from the received signal.

18. A signal transmission system according to claim 17, wherein each of the first and second data streams carries information constituting a television image.

19. A signal transmission method comprising:

receiving an input signal containing a first data stream of n values and a second data stream, where n is an integer;

modulating a carrier wave with the received input signal so as to produce a modulated signal having symbols each representing a corresponding one of m signal points in a signal space, where m is an integer;

dividing the m signal points into n signal point groups;

assigning n values of the first data stream to the n signal point groups, respectively, and assigning data of the second data stream to the signal points of each of the n signal point groups;

shifting the signal points of the received signal to other positions in the signal space such that a distance between any closest two signal points of any adjacent two signal point groups becomes 2δ * S and the signal points in each of the signal point groups are allocated in the signal space at equal intervals, and such that the m signal points are distinguishable from one another in the signal space by a first set of thresholds, which divide the signal space into m regions, and the n signal point groups are distinguishable from one another in the signal space by a second set of thresholds, which divide the signal space more coarsely than the first set of thresholds into n regions, where 2δ is a distance between the closest two signal points of the adjacent two signal point groups when the m signal

points are allocated in the signal space at equal intervals, and S is a shift coefficient which is more than one; and

transmitting the modulated signal and information necessary for determining the first and second sets of thresholds.

20. A signal receiving method comprising:

receiving a signal having symbols each representing a corresponding one of m signal points in a signal space, where m is an integer, wherein the m signal points are divided into n signal point groups each containing m/n signal points, and the signal points are shifted to other positions in the signal space so that a distance between any closest two signal points of any adjacent two signal point groups is $2\delta * S$ and the signal points in each of the signal point groups are allocated in the signal space at equal intervals and the m/n signal points in each of the n signal point groups are distinguishable from one another in the signal space by a first set of thresholds and the n signal point groups are distinguishable from one another in the signal space by a second set of thresholds, where 2δ is a distance between the closest two signal points of the adjacent two signal point groups when the m signal points are allocated in the signal space at equal intervals, and S is a shift coefficient which is more than one, and wherein the signal contains a first data stream, which is assigned to the n signal point groups, a second data stream, which is assigned to the m/n signal points of each of the n signal point groups, and information necessary for determining the first and second sets of thresholds;

extracting the information necessary for determining the first and second sets of thresholds from the received signal and setting at least one of the first and second thresholds based on the information necessary for determining the first and second sets of thresholds;

distinguishing the n signal point groups from one another by the second set of thresholds and demodulating values of the distinguished n signal point groups to obtain reconstructed data of the first data stream, and distinguishing the m/n signal points in each of the n signal point groups by the first set of thresholds and demodulating values of the distinguished m/n signal points in each of the n signal point groups to obtain reconstructed data of the second data stream; and

combining the reconstructed data of the first and second data streams to obtain reconstructed data from the received signal.

21. A signal transmission method comprising:

receiving an input signal containing a first data stream of n values and a second data stream, where n is an integer;

modulating a carrier wave with the received input signal so as to produce a modulated signal having symbols each representing a corresponding one of m signal points in a signal space, where m is an integer;

dividing the m signal points into n signal point groups;

assigning n values of the first data stream to the n signal point groups, respectively, and assigning data of the second data stream to the signal points of each of the n signal point groups;

shifting the signal points of the received signal to other positions in the signal space such that a distance between any closest two signal points of any adjacent two signal point groups becomes 2δ * S and the signal points in each of the signal point groups are allocated in the signal space at equal intervals, and such that the m signal points are distinguishable from one another in the signal space by a first set of thresholds, which divide the signal space into m regions, and the n signal point groups are distinguishable from one another in the signal space by a second set of thresholds, which divide the signal space more coarsely than the first set of thresholds into n regions, where 2δ is a distance between the closest two signal points of the adjacent two signal point groups when the m signal points are allocated in the signal space at equal intervals, and S is a shift coefficient which is more than one;

transmitting the modulated signal and information necessary for determining the first and second sets of thresholds;

receiving the modulated signal;

extracting the information necessary for determining the first and second sets of thresholds from the received signal and setting at least one of the first and second thresholds based on the information necessary for determining the first and second sets of thresholds;

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distinguishing the n signal point groups from one another by the second set of thresholds and demodulating values of the distinguished n signal point groups to obtain reconstructed data of the first data stream, and distinguishing the m signal points in each of the n signal point groups by the first set of thresholds and demodulating values of the distinguished m signal points in each of the n signal point groups to obtain reconstructed data of the second data stream; and
combining the reconstructed data of the first and second data streams to obtain reconstructed data from the received signal.--